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the FINAL FRONTIERS OF NETWORKING, PART II: YOU ARE THE NETWORK

By Kevin Werbach

Ubiquitous networking will require the alignment of hardware, software, infrastructure, standards and business models. The steady progression of Moore's Law has given us handheld computers, wireless phones, two-way pagers and other tiny toys with more processing power than a high-end PC of only a few years ago. Devices such as the Palm connected organizer and the Diamond Rio digital music player are proliferating. Yet these tools seldom talk to one another. Extending networking to personal and embedded-processor devices will involve several intermediate steps, each of which will generate new business opportunities.

We recently described the nascent market for home networking (see Release 1.0, 12-98). In this issue, we examine the other major environments that remain un-networked. These fall into two broad categories: personal-area connections and embedded-processor devices. In both cases, physical limitations and hardware heterogeneity pose significant challenges not present in the office or even in the home. Ubiquitous networking is some way away, but pockets of connectivity will emerge much more quickly.

Computing in a networked world will be fundamentally different from today. Software will largely be transformed into services, while hardware platforms become increasingly diverse. The distributed networks of the future will not simply re-create the centralized time-sharing of the past. Instead, ubiquitous networking will foster greater heterogeneity and personalization of the user experience. People will make use of services and data as needed, rather than locking themselves into a particular environment.

PCs won't go away, but they will be only one kind of tool for communicating and getting information. IDC predicts that 55 million information appliances will be shipped worldwide in 2002, 30 percent of which will be handheld devices. In less than five years, we believe, a majority of the devices capable of connecting

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to the Net will be handheld wireless smart phones and networked personal digital assistants (PDAs).

Looking too far ahead is dangerous, however. Intermediate steps will determine how quickly change occurs and which products are successful. Moreover, there's a big difference between the ability to receive Internet content on a device and a useful service. As we discuss below, ubiquitous networking will require: intelligent devices with built-in wireless networking capabilities; short-range personal-area connection standards and associated application frameworks; end-to-end services offered over wide-area wireless data networks; content transmission and reformatting technologies to bridge the gap between PCs and other devices; and mechanisms for embedded-processor devices, new and old, to take part in the Internet protocol (IP) revolution.

Another challenge, beyond the scope of this issue, is design-related. Information appliances must be robust and easy to use if they are to serve the mass market. The design philosophy of the computer industry no longer works in this new environment, and even great ideas often fail because they fail to gain a critical mass of users. For a thorough analysis of this problem and some thoughts about solutions, we recommend Don Norman's insightful recent book, The Invisible Computer.

People, places and things

Networking has traditionally been directed at places: wiring an office, a building or a home. The next steps will be connecting people and things.

These new forms of networking will differ from home and office connectivity. Time and purpose will be more important than place, or rather, place no longer defines purpose. The important variable isn't where you are, it's what you're doing at a given moment. (For those so inclined, UCLA geography professor Michael Curry's paper, "New Technologies and the Ontology of Places" offers a more theoretical analysis of the relationship of technology to space. See resources section.)

Networking in the office and the home grew up around the PC. Desktop software has begun to evolve based on the presence of connectivity, and information appliances are starting to emerge. For networking people and devices, a traditional PC and Ethernet connection isn't even a viable option in most cases. Cost, size limitations, power consumption and reliability are just some of the challenges when you move networking beyond the home and office.

The ubiquity of IP ensures that once devices are connected, they will have access to the full benefits of the global network. IP is powerful because it is a low-level foundation that does not assume specific classes of applications (see Release 1.0, 2-99). On the other hand, because IP alone determines so little, more intelligence at the edge of the network will be required to bring non-traditional devices into the fold. You can't simply plug an Ethernet cable into a toaster or a blood analyzer and assume the device is networked. There has to be some software either in the device or in some intermediate proxy server that understands the local applications and the constraints of the device environment.

WIRELESS DEVICES: This year’s models

Putting enough computing power into the palm of your hand to be useful is a major challenge in itself. Adding wireless networking, while still meeting weight, size, price and power-consumption goals, is even harder. But devices such as PDAs will never reach their potential without built-in networking. As Tom Zimmerman of IBM’s Almaden research lab observes, “Our PDAs are screaming for data communications.”

It’s important to distinguish between circuit- and packet-switched wireless connections (see Release 1.0, 6-98). Circuit-switched networks, such as the wireline telephone network, require users to dial up each time they wish to connect. The network dedicates a channel to each communication. By contrast, packet-switched networks are always on. Many users can share the same channels because communications are split up into packets routed over multiple circuits. This, as much as the greater bandwidth, is what distinguishes the Internet experience on an office LAN from a phoneline connection at home. Having an always-on connection, for example, means you can be notified whenever you receive an e-mail or an instant message, without having to consciously connect to the network.

Wireless voice networks have traditionally been circuit-switched. The dial-up paradigm makes sense if you think of a cellular phone as analogous to a modem and a portable information device as the equivalent of a desktop PC. However, the promise of wireless data networking is something greater: pervasive, near-immediate information access. You don’t think about dialing up when you open your wallet or your address book, or when you glance at your watch. All of those devices have value because they are readily available when you need them... but their information can become stale. Wireless connectivity means a vastly greater array of services can be made available, but we won’t start to think of them in the same terms as their physical counterparts until we transcend the circuit-switched model. In other words, packet-switched access is a key foundation for true information appliances, as opposed to mobile PCs.

Two recently announced devices offer the kind of always-on wireless connectivity we describe: the Palm VII and the RIM BlackBerry. Both are designed to operate over the BellSouth Wireless Data Network, formerly known as RAM Mobile Data (see Release 1.0, 10-92). BellSouth acquired full control over RAM in 1997. Today the network, based on Ericsson’s Mobitex packet-switching technology, offers coverage of 90 percent of the US population, and the service is also available in parts of Canada. Tim Meyer, director of business development for mobile e-commerce at Ericsson, says the secret sauce that makes Mobitex effective for wireless Internet services is its power efficiency. Just tracking where a device is physically located generates significant background network traffic.

Palm VII

Wireless connectivity is a natural addition to 3Com’s phenomenally successful Palm devices. Palm and third-party vendors offer wireless modems that attach to the current devices, but these generally operate in circuit-switched on/off mode and must be purchased separately.

In December, 3Com announced it would offer a version of the Palm later this year with built-in wireless connectivity. The Palm VII will be priced at less than $800, not counting monthly subscription fees of $9.95 per month for the first 50k and 30 cents per kilobyte thereafter. Palm will offer Web content using “clipping” technology that displays the main content from participating sites in a format better suited for a small handheld display. Forms are stored in local applications on the device rather than downloaded each time, reducing the amount of network traffic. Palm announced over 20 content partners including ABC News, ESPN, E*Trade, TicketMaster, Travelocity, USA Today, the Wall Street Journal and Yahoo! that would participate in the service.

We think the Palm VII will be the Newton of handheld Internet connectivity: a big step in the right direction, a status symbol for the geek elite, but not yet the product that changes the world. The price, especially the usage charges for downloading information, will limit its mass-market appeal. The clipping approach to Web content means users may find many of their favorite sites inaccessible, because the Palm VII’s client software interfaces only with the Palm.net proxy server. With new wireless data networks and content reformatting technologies (see page 12) on the horizon, though, a Palm device without these limitations may not be far off.

RIM BlackBerry

The Research in Motion (RIM) BlackBerry system is designed for a specific function: mobile access to e-mail. The solution consists of a two-way pager, airtime on the BellSouth Wireless Data Network, and software to synchronize messages on the device with Microsoft Exchange servers. When a message is received at the server, it is forwarded to the device in compressed and encrypted form, without requiring the user to connect or issue a request. Because the system is integrated with Exchange and Outlook, it offers address book, calendaring and task lists in addition to e-mail. Messages sent from the BlackBerry unit have the same return address as desktop-created messages, and RIM incorporates Puma’s Intellisync technology to keep desktop and handheld mailboxes consistent.

The handheld device, about the size of a two-way pager, includes a specially designed 32-bit Intel 386 and two megs of memory. RIM claims this is enough to store several thousand contacts, appointments, tasks and e-mail messages.

Coming soon...

Companies such as Ericsson, Qualcomm, Nokia and Motorola are all pursuing this market. Each product will make a different tradeoff between features, price and weight, as vendors search for the sweet spot in the market. AT&T already offers wireless Net access through its PocketNet service, but it has met with limited success due partly to the bulky Mitsubishi and Samsung phones it requires. Pricing and coverage limitations have also handicapped PocketNet. The way these new services handle content will also be important; Web content reformatting and seamless connections to corporate servers can be the difference between a gimmick and a truly useful service.

We suspect there will be two viable price points in the smart phone market: data-enabled wireless phones at $100 to $200 and multi-function wireless communicators for $500 to $800. The former devices will gradually replace conventional wireless phones, just as most phones today build in features such as address books and voice mail. Even users who don't avail themselves of the data features will have them available, because the incremental hardware cost will be sufficiently low. The higher-end devices will compete with PDAs and more computer-oriented devices.

PERSONAL-AREA NETWORKING

Increasingly, people carry computing devices with them at all times, whether a handheld PC, a cell phone, a pager, a digital audio player, a handheld game machine or something even more exotic. Seventy million people in the US now have wireless phones, which are rapidly gaining features and processing power. In other regions such as Scandinavia and Israel, wireless penetration is even greater. About 160 million wireless handsets were sold worldwide in 1998, and Nationsbanc Montgomery Securities projects 1999 sales of over 210 million units. Looking farther into the future, Nokia's ceo predicted in September that there will be one billion wireless users in 2005.

However, for the most part all these devices people carry are self-contained worlds. Not only are they incapable of communicating with each other, they often aren't designed to communicate with stationary devices (printers, PCs, TVs) located nearby.

People move around, so almost by definition, personal-area networks will be wireless. As IBM's Zimmerman notes, "If we were trees, this wouldn't be an issue. But we're mobile creatures." These networks will need to tap into wide-area connections such as cellular data networks or wired base stations, but will gain significant functionality through local-area networking. Relatively low-speed local connections are sufficient to share address books between handheld computers and smart wireless phones, for example. The critical elements are price and ease of use; local wireless connections must be automatically established when a device comes in range (with appropriate security to prevent unauthorized data transfers), and radios must not add significant cost or complexity to devices.

To start networking personal devices, we don't need to wait for a ubiquitous broadband wireless IP infrastructure. Chips and radios that support long-range, high-speed connections will always be more expensive and consume more power than those designed for short-range networks. Advances in digital signal processing and other technologies will bring down costs over time, but someone will still have to build and pay for the wireless transmission infrastructure. The beauty of personal-area networks is that they don't require a network of transmission towers, because they don't try to cover long distances.

Bluetooth

Bluetooth is a consortium promoting an emerging standard for personal-area wireless networking. The technology will be built into chips initially costing about $20 but moving down to $5 in volume, and will allow up to eight devices to form an ad hoc network within a range of about 10 meters.

The original driving forces behind Bluetooth were IBM, Intel, Toshiba, Ericsson and Nokia. There are now more than 500 companies in the Bluetooth special interest group, as the consortium calls itself. At this point Bluetooth isn't part of any formal standards organization, but it may submit its specification to a standards body at some point in the future. Microsoft has been notably absent from the group, saying it won't agree to the organization's zero-cost intellectual-property licensing requirements. However, there isn't currently any competing initiative in the same space.

Bluetooth specifies a chip-based radio frequency transceiver in the globally-available unlicensed 2.4-ghz range (see Release 1.0, 12-98 for more on the appeal of this frequency band). As many as eight devices can be connected to one ad hoc "piconet," and several local piconets can be chained together as long as they are within physical proximity. The standard supports 432-kbps symmetric and 721-kbps asymmetric data rates, or up to three voice channels per local network. Because it's a radio frequency (RF) technology, Bluetooth works based on proximity rather than line of sight. Any devices within range can communicate with one another, should you so desire.

The first version of the Bluetooth specification is due in June. Despite the appeal of an industry standard, it will take time for Bluetooth to move from concept to reality, and longer to move from reality in silicon to widely-available products. By 2001 or perhaps 2002, though, Bluetooth should start appearing on most mainstream wireless and handheld devices. 3Com vp of home networking Roy Johnson says that Palm devices with built-in Bluetooth radios should be available next year. The Palm currently includes an infrared transmitter, but it can share data only with other Palm devices.

One significant problem with Bluetooth today is that it is incompatible with the HomeRF standard (see Release 1.0, 12-98). HomeRF is designed for wirelessly connecting stationary devices in a home with a range of about 50 meters; it promises higher bit rates than Bluetooth and also includes voice protocols developed for cordless telephones. Bluetooth and HomeRF devices may interfere with one another, which is a serious problem that engineers in both groups are currently working to address. Several companies are members of both the Bluetooth and HomeRF consortia, so it seems likely that the interference will be resolved.

Chicken and egg

Which comes first: the device or the network? We haven't seen personal-area networks before now partly because devices with the necessary form factors and power consumption for mobile use haven't been feasible to build. On the other hand, tens of millions of people now have both laptop computers and wireless phones but don't use them together because of limitations of existing wireless data networks. Networks and devices evolve independently. Which services are viable shifts depending on the balance at any given time.

Connectivity and devices also influence each other. Without connectivity, each device has to include all the applications and features a user needs. Stand-alone devices are also more difficult or even impossible to upgrade.

Such devices will therefore tend to be more bulky and PC-like, unless they are so simple and cheap that users tolerate limited functionality.
One of the key breakthroughs of the PalmPilot was its ability to synchronize with a PC. The Palm applications didn't need to have all the functionality of desktop PIMs and databases, because users could do the heavy lifting on a PC and easily transfer information to the handheld device. Synchronization is a very limited form of networking; always-on connectivity will allow devices to become even easier to use. When the Palm was introduced, however, wireless data networking was not a viable option. Now it is, hence the Palm VII (see page 3).

The hard part of this equation is that networks must reach a critical mass of usage to be successful. It doesn't make sense to deploy a national wireless network unless you're pretty confident there will be enough customers to justify your investment. But device manufacturers won't add connectivity to non-existent networks unless the additional hardware is virtually free... which is the case with the point-to-point infrared connectivity now built into Palm and Windows CE devices.

One device or many?

Personal-area networks are important partly because no single device will incorporate all the functions that most people want. Part of the problem is technical: miniaturizing components to the point where they can be combined into a single unit, while still observing battery power and cost limitations. But even as it becomes possible to cram additional features into a single package, there are market constraints on integration.

Given a choice between a single device that incorporates computing, communications and audio features and three separate devices that each cost much less, weigh less, take up less space, and do a better job at a specific function, most consumers will opt for the latter scenario. Companies will naturally build devices at the price points and form factors that appeal to the broadest potential audience. The Newton had many capabilities that the PalmPilot did not, but the tradeoffs in terms of weight, ease-of-use and price were too great for the platform to succeed.

Another important factor pushing towards multiple personal devices is flexibility. Some consumers value the ability to carry around digital music or trade stocks through a wireless connection more than others. Companies that are good at building one type of device won't necessarily be experts at other functions. Users will want to pick best of breed products rather than being locked into single-vendor solutions.

This is not to say that every device will be single-function, or that most people other than Dave Farber and Bob Frankston will carry around six or seven different pieces of electronics at all times. People will tend to have a "home" device that they use most of the time, which in most cases will be either a handheld computer or a smart wireless phone, and those two classes of devices will gradually converge. With personal-area networks, if you receive a call on your wireless phone while you're listening to your digital music device through headphones, you'll simply pause the song and patch through the call rather than pull the phone out of your pocket or purse. As today, some people will be more gadget-oriented than others.

Getting really personal

The ultimate form of personal networks will use people themselves as the network conduit. Working with Neil Gershenfeld at the MIT Media Lab, Tom Zimmerman designed a low-frequency 0.5-mhz wireless networking technology that passes signals directly through the body and has a range of about one meter. Zimmerman moved to IBM's Almaden research facility in 1995 and has been perfecting the technology ever since.

Using this technology, which Zimmerman calls personal-area networks (PAN), people could exchange business cards or other information by touch. Zimmerman himself says the two most immediate applications are synchronizing personal devices such as PDAs and laptops, and authentication.

"Think of the world in the 50's when everything was unlocked," Zimmerman explains. "Now in the 90's everything is locked, which gives you pretty good security with terrible access." PAN promises the best of both worlds. Using PAN, a user automatically transmits an encrypted ID to a device when she comes within range of the electrical field.

IBM has filed several patents relating to the security aspects of the technology. For example, because the user ID is encrypted, merely walking past a third-party base station won't broadcast personal information unless the user so desires. IDs can also be time-based. Imagine that when you arrived at a hotel, instead of checking in you simply received your room number at a kiosk or on a PDA. With door locks keyed to your personal wireless transmitter for the duration of your stay, you wouldn't have to stand in line to receive a key.

Zimmerman is pursuing the technology with potential enterprise customers, one of which will begin deployment late this summer. He now sees PAN coexisting with Bluetooth, which has the advantages of greater range and broad industry backing. Many of the applications Zimmerman has been developing easily translate from electric-field PANs to radio-frequency Bluetooth systems. However, the two can also complement one another. PANs with their shorter range, are more appropriate for individual authentication scenarios such as logging a single user onto a PC. A Bluetooth signal in the same scenario would reach every PC within 10 meters. The two technologies could share many of the same hardware components, and because their frequencies are so different interference isn't a problem.

The subtle significance of PANs is that they allow mobile devices to be extremely lightweight, because most of the data remains on central servers. "It turns out that in the networked world, for 90 percent of the applications all you have to do is identify the customer to the enterprise," Zimmerman explains. "Once you're identified, all the records are already in the enterprise's computer." It's the one-click ordering model of e-commerce Websites, with PANs taking the place of cookies on the user's hard drive.

"The world is wonderfully networked up until the last 10 meters," Zimmerman says. "I'm wiring up the most important part, which is us."

Geography matters after all

Moreover, personal-area networking doesn’t just mean connectivity between several devices on a single person. The same technologies will allow networks to be established automatically between people near each other. Bring your laptop or PDA into a conference room, and you’ll automatically be able to share files, audio or instant messages with others in the same meeting. Meet a new acquaintance and you’ll be able to exchange contact information at the touch of a button. (PDAs already offer this functionality through infrared beams, but the transmitters must be in line of sight and not all devices use the same standard.) Personal-area networks will also make it easy to connect handheld devices to stationary peripherals or networks if they happen to be nearby.

The result will be similar to today’s home entertainment centers. People have many different configurations in their homes: just a radio, all-in-one radio/CD player/tape deck units, component systems, all the way to home theatres tying together eight or ten separate boxes. The networking interfaces for these devices are relatively standard, which means consumers can choose each piece of equipment on its own merits and then plug it into the others. New consumer electronics networking technologies such as Firewire and high-speed home networks will extend this model beyond traditional audio and video equipment (see Release 1.0, 12-98). With regard to personal-area networking, though, devices are still for the most part self-contained islands.

THE GOLDEN AGE OF WIRELESS DATA?

Waiting for networks

Existing wide-area wireless data networks are significantly limited. Data-only networks such as Ardis and RAM Mobile Data (now owned by BellSouth) have been around for the better part of a decade, and several voice systems employ cellular digital packet data (CDPD) or data over personal communications system (PCS) technology to transmit packets (see Release 1.0, 10-92). These systems, however, typically support data rates of 9.6 kbps or less, with high latency and spotty coverage aggravated by high prices. Moreover, none of the systems were designed for IP connectivity, meaning they rarely support existing applications such as corporate e-mail servers. Compatibility issues between equipment and between different networks when users are on the road are also a serious problem.

Carriers and equipment vendors are developing enhanced cellular data networks that promise data rates up to 144 kbps, which is sufficient for many data applications such as checking e-mail, synchronizing address books and updating schedules. On the horizon is the third-generation wireless (3G) standard, designed to support data rates up to 2 mbps on a fixed basis or 144 kbps mobile. The 3G standard had been held up because of patent disputes between Qualcomm and Ericsson, but last month the two companies finally reached a compromise. Qualcomm and Ericsson signed a cross-licensing agreement, and the Swedish company agreed to purchase Qualcomm’s infrastructure business.

The International Telecommunications Union has tentatively endorsed a 3G standard that encompasses both Qualcomm and Ericsson's approaches, as well as the competing time division multiple access (TDMA) technology favored by AT&T. Hybrid phones could support all three standards, a messy solution that at least holds out the possibility that a single device may offer global high-speed wireless connectivity. Still, 3G services probably won't be widely available before 2002 or 2003. Even once the transmitters and phones are available, deploying new wireless base stations across cities and countries is a several-year process. Similarly, the Cisco-Motorola alliance announced in February to develop an all-IP wireless data platform will have a major effect on the market, but will take four to five years to reach fruition.

Metricom's Ricochet service is available in San Francisco, Seattle and Washington, DC, as well as several major US airports. It offers 28.8-kbps wireless IP access, with additional cities and a 128-kbps service under construction. However, the company has struggled to market the service effectively. Ricochet is built around a wireless modem card for laptops. It makes the most sense in situations where customers can use a computer but aren't near a LAN or phone line. That's great for Silicon Valley venture capitalists, but evidently not compelling to most people.

Effective wireless data services require a platform. Compatibility is one piece of the puzzle: Smart wireless phones such as the Nokia 9000 series have offered data features to users in Europe and Asia for more than a year, but the US operates on incompatible wireless standards. Another critical element is the need for end-to-end services, which companies such as Wireless Knowledge are beginning to tackle.

Wireless Knowledge

Microsoft and Qualcomm formed Wireless Knowledge in November 1998 to provide wireless access to applications. Given Microsoft's involvement, that initially means connecting Windows CE devices to corporate Exchange servers. The company plans to offer services on an OEM basis to wireless carriers, allowing them to provide services such as mobile e-mail, Web access and virtual private network connections.

Wireless Knowledge has about 50 employees based in Qualcomm's hometown of San Diego, CA, and most of its top management comes from the wireless technology company. Ceo John Major says the company's other parent also plays an active role and provides access to engineering expertise in Redmond. Wireless Knowledge also has a relationship with General Magic, which will integrate its Portico voice-based unified messaging platform.

Wireless Knowledge's vision is to make wireless access ubiquitous for mobile professionals. The company will offer an end-to-end solution so that these end-users can interact with their corporate Exchange server as if they were sitting in their offices using a networked PC. Major says that by 2002, wireless information devices will be as widely used as PCs for Internet access. "We think the trend [toward wireless access] is so big that it will change the way applications work," he argues, "and it will change the kind of applications that are of interest to people."

Wireless Knowledge's solution will allow mobile users to tunnel into their corporate servers over a wireless virtual private network (VPN), giving them secure direct access to files and shared information. Wireless Knowledge will also offer hosting services, either at its own facilities or at a carrier. Major believes companies will eventually depend on carriers to host their groupware and wireless data services, just as they use outsourced voicemail today. It will take a few years, though, for customers to become comfortable with this approach.

Of course, not everyone uses Exchange and Windows CE. So far the Palm platform has far outsold Windows CE devices. However, Wireless Knowledge is aiming not only at PDAs but also at smart phones; Qualcomm's strong position in the wireless market gives the partnership a foundation in this arena. The company claims to be agnostic about whether its services run over networks using Qualcomm's code division multiple access (CDMA) technology or competing standards; Qualcomm is confident that the benefits of CDMA will become increasingly pronounced as more data-oriented services are rolled out.

On the groupware side, Lotus offers a wireless gateway for Notes and Domino servers, but doesn't currently have an end-to-end service like Wireless Knowledge's. Major says Wireless Knowledge will eventually build solutions for other groupware packages such as Notes, but explains that there are enough Exchange shops to keep the company busy for a while.

Major argues that the digital networks needed to support wireless data services are just now becoming available with sufficient scale and coverage. He believes that as customers see the benefits of always-on wireless packet data connections to their corporate groupware and other applications, "synchronization is going to go away."

Symbian

Psion, the leading European vendor of PDAs, spun off Symbian in June of last year to have a stronger position against the onslaught of Windows CE. The company is a now a privately held joint venture of Ericsson, Nokia, Motorola and Psion, based in London. Symbian is licensing the Epoc real-time operating system, originally developed by Psion, to interested manufacturers of wireless information devices. EPOC isn't an acronym; Psion wanted to suggest that it would enable a new epoch in convenience.

Given the ownership of the company, Symbian tends to be more focused on communications, whereas Wireless Knowledge has a stronger interest in the computing side. However, the gap between these two worlds is closing quickly. Symbian has defined reference designs for smart phones and PDA-type communicators, but it has left open a significant range of possible functionality that licensees could build on the platform.

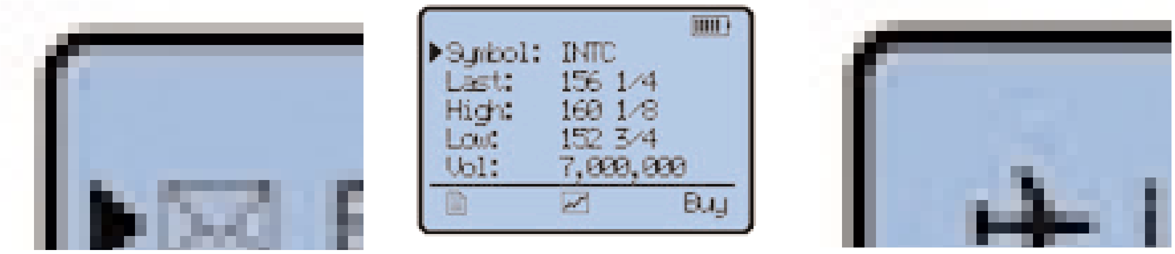
At the CEBit show last month in Germany, Symbian announced an alliance with Sun to incorporate Java into EPOC devices. Java will give Symbian devices the ability to run a much broader range of applications, and to leverage content and services developed in Java on other platforms. Symbian also plans to incorporate Bluetooth (see page 5) and the wireless access protocol (see page 12) into its platform.

CONTENT FORMATTING AND STREAMING

Any effort to make data applications available to wireless devices must address the physical limitations of handheld form factors. PDAs and wireless phones don’t have the same amount of screen real estate and graphics capability as the typical PC. Moreover, each device may be different, far more different than today’s browsers and PCs.

Formatting and selecting information to fit onto a wireless device is only part of the challenge. Bandwidth is usually at a premium on wireless networks, connections are less reliable, and greater latency compounds the difficulty of transmitting large amounts of data. Protocols such as HTTP and TCP are relatively inefficient, and were designed for wired networks.

The wireless application protocol (WAP) was designed to address these issues. WAP grew out of work by Unwired Planet, one of the first companies to develop a micro-Web browser for wireless devices. Unwired Planet was ahead of the market, so it has tried to drive an industry standard to increase the adoption rate of its technology.



▶Symbol: INTC
Last: 156 1/4
High: 160 1/8
Low: 152 3/4
Vol: 7,000,000

Figure 1: The Unwired Planet micro-browser running on a wireless phone.

The WAP Forum, founded in June 1997 by Ericsson, Motorola, Nokia and Unwired Planet, now includes 90 companies. It published its first spec in May 1998. Handset manufacturers representing 75 percent of the current market have now committed to shipping WAP-compliant products.

WAP includes a full protocol stack that mirrors the traditional Internet TCP/IP stack, but optimized for wireless networks. This allows WAP networks to handle existing Internet content including Java and CGI scripts. WAP also includes a specification for the wireless markup language (WML), an XML-based standard for content creation similar to HTML. Content authored in WML will run on any WAP-compliant device, and over any WAP-compliant network. Wireless carriers must deploy proxy servers to convert information between WAP and traditional Internet protocols.

The downside of WAP is that content must be re-authored in WML, though tools will no doubt be developed to help with the task. Because WAP is designed primarily for wireless phones, content providers may have to use yet a different format for larger-screen devices such as PDAs or stationary screen phones.

Investing in the wireless future

Seth Goldstein, founder of online ad agency SiteSpecific and Root.net, a concierge service for mobile professionals, recently joined New York venture capital firm Flatiron Partners to head up a new $50-million pervasive computing fund. He sees a burgeoning revolution at the intersection of the Web, wireless technology and consumer electronics, although so far good examples are limited.

Goldstein believes the devices themselves are less significant than the applications surrounding them. Getting information onto one device is less of a challenge than portability between multiple devices, he says, which will become increasingly important.

Goldstein also sees advertising as a significant element in the wireless device market of the future. Companies such as Free-PC have generated attention by giving PCs to customers willing to provide detailed demographic information and to view targeted ads. The same model seems even better suited to wireless information devices, which are cheaper and used for specific functions that can be directly tied to ads. If you're using a Palm VII to handle your shopping list in a supermarket, for example, there's a perfect opportunity to present you with a coupon or ad for, say, tuna-free dolphin meat.

Online Anywhere

The alternative to WML is to reformat content on the fly. Online Anywhere, headquartered in Palo Alto, CA, was founded in 1997 as Vidam Communications. It has funding from Draper Richards and Motorola Ventures, and currently has 22 employees. The company's first product, PC/TV, converts HTML content for viewing on television sets. In January, Online Anywhere announced Oasis, which reformats HTML content for viewing on a range of information appliances such as cell phones, Internet-TVs and PDAs.

Founder and ceo Mohan Viswanath previously worked at Xerox PARC in the pervasive computing group. He says PARC researchers in the 1980s and early 1990s developed a good understanding of how the computing world would move beyond PCs, but couldn't predict the killer application for networked devices until the Net emerged. The success of the PalmPilot provided an additional lesson: Users form habits that are hard to break. Earlier PDAs assumed that users would give up their familiar desktop applications, but the PalmPilot offered easy synchronization with desktop PCs. Viswanath sees similar dynamics occurring on the Net, as users become familiar with particular sites such as Yahoo! and E-Trade.

Online Anywhere's goal is to make it easier for users to stay with their favorite Websites when they move to non-traditional devices such as smart phones, PDAs and TV set-top boxes. Viswanath believes content providers are the key element in the Web value chain for wireless data. Service providers and device vendors depend on the availability of sufficient content, but they aren't used to being responsible for how content is formatted for an effective user experience. Content providers know how they want their content to be presented, but they are leery of re-authoring everything for each class of information appliance. For massive sites such as Yahoo!, reformatting everything using WML hardly makes sense, but if wireless Net access does take off Yahoo! may be at a disadvantage against sites that focus on creating content for new wireless platforms.

Oasis is browser-, device- and protocol-agnostic. The server identifies requests originating from non-PC devices through user agent information that is passed automatically through the HTTP headers in a Web connection. Currently, Online Anywhere's employees must maintain and update a database of devices and their characteristics. However, Online Anywhere is participating in a World Wide Web Consortium (W3C) working group to develop a standard for HTTP to pass recommended screen resolution automatically. When a request comes in from a device such as a PDA or a set-top box, it is redirected to the Oasis server for content reformatting.

The Oasis software is modular so that in addition to sitting at the content provider as either part of the Web server or a proxy server, it can be located at a home gateway or even in a client device. For example, if a user has a home network with a PC at the center, the Oasis software can reside in the PC so that other devices see reformatted content.

Online Anywhere's FlashMap technology uses natural language processing techniques to analyze the semantic content of a page. Viswanath won't go into more detail, saying that the company has applied for five patents on the technology. Content providers can set display parameters for each of four classes of devices: smart phones, PDAs, TV-based devices and voice-only devices. The Oasis server automatically reformats content for the appropriate class of device.

Translation Error.
No Disk File

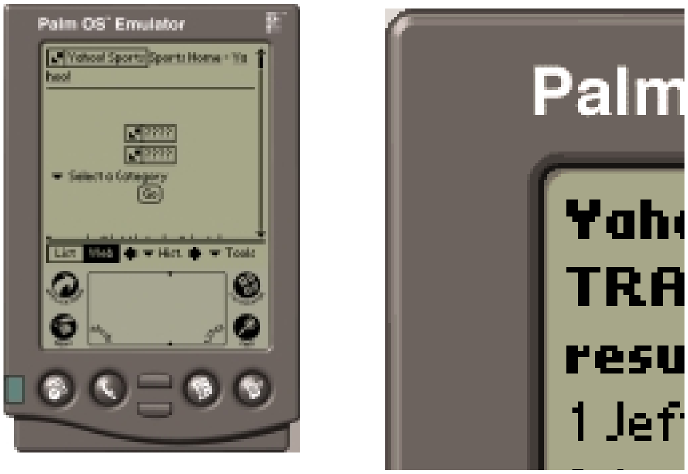


Figure 2: A Web page (left) displayed directly on a Palm device (center) and reformatted with Online Anywhere's Oasis (right).

Earlier this month Online Anywhere announced an agreement with Yahoo! to use Oasis as the foundation for Yahoo! Everywhere, an effort to deliver Yahoo! content to a broader range of devices. Viswanath won't reveal the terms of the deal, but says that Online Anywhere offers content providers a choice of an annual licensing fee or a lower annual fee coupled with usage charges. Online Anywhere plans other deals with content and service providers soon.

Proxinet

Reformatting Web content for handheld devices is a computationally-intensive task. Proxy servers must separate pages into components including text, graphics and forms, transform each component in an appropriate manner and then reassemble the pages in a visually-appealing manner for display on the device. Systems must be able to handle thousands or even millions of devices, without introducing excessive delay. Architecturally, therefore, scaling is as significant a challenge as the content-reformatting algorithms themselves. Proxinet, which grew out of the same UC Berkeley research group that spawned Inktomi, attacks the problem of delivering Web content to handhelds from this angle.

The company, currently based in Emeryville, CA but moving to San Francisco shortly, has 30 employees and venture funding from Softbank, Oracle co-founder Don Lucas and former Citrix ceo Tyrone Pike. Founder Armando Fox developed a distributed architecture for content reformatting and delivery as part of his Ph.D. thesis in computer science. Current cto Elan Amir, a classmate of Fox at Berkeley, did his thesis on real-time multimedia transmission to heterogeneous environments, including wireless devices. Ed Snyder, who has been involved in several startups in the networking and network monitoring space, joined as ceo last month.

Amir describes Proxinet's mission as follows: "Handhelds up to now have been surrogates of PCs. We challenged that assumption. What we set out to do was to transform these devices into full Web clients." The company launched its ProxiWeb system, which initially supports Palm and Windows CE devices, earlier this month at the DemoMobile conference. ProxiWeb uses a three-tier architecture: a cluster of ProxiWare servers reformats content delivered from a Web server in real-time, then delivers it in compressed, encrypted form to the ProxiWeb client running on the mobile device.

Amir emphasizes that ProxiWeb allows access to any Website, without any re-authoring. The system supports text, graphics and forms, but not Java or Javascript. Because it offers a secure link between the device and the proxy server, which can also host cookies, ProxiWeb supports e-commerce transactions directly from handheld devices.

Translation Error.
No Disk File

Figure 3: ProxiWeb client displaying content on a Palm device.

ProxiWeb is modular, which allows it to support any client device capable of running a micro-browser. The device identifies itself during the initial handshake with the proxy server, which loads the appropriate module for that screen resolution and color depth. Just as Inktomi uses clustering to rapidly deliver search results, cached content or shopping comparisons, Proxinet uses a distributed network of inexpensive servers to offer real-time delivery of reformatted content. Amir thinks this built-in scalability will give Proxinet an advantage over competitors such as Online Anywhere as wireless Web access takes off.

Amir believes that it's essential to deliver content in an appropriate manner for mobile use, beyond simply fitting a small screen. "When you're in the field, and you've got a handheld device, what you're about is not lazy Web surfing, it's information access," he explains. "The attention span of the mobile user is very very short, and the information he or she needs has to be easy to get at." And Web access is only the beginning, Amir contends: "We are in the process of putting together a grand plan for the types of things that mobile users would want, leveraging ProxiWare."

The company will pursue two business models, according to Snyder. For large corporations interested in offering employees mobile access to enterprise applications, Proxinet will sell server licenses so that the customer can host the proxy cluster behind its firewall. Alternatively, Proxinet will sell ProxiWeb to wireless service providers or content providers, based on some combination of license fees and revenue sharing.

Thinking Media

People familiar with Thinking Media, a startup based in New York, generally think of it as an online advertising company. The company began in 1995 as a Web design and advertising agency, and it still develops campaigns and consults for clients such as Procter & Gamble and Disney. However, Thinking Media is really a technology company in disguise. Its ActiveAds platform allows companies to create rich media ads that Web users can interact with, right in the ad banner. Its ActiveTrack tracks banners on the client side and automatically sends data back to a server where it can be analyzed. Advertisers can find out how long a user sees an ad, for example, because the system knows when the page is refreshed on the client.

For the purposes of this issue, though, we're interested in another aspect of Thinking Media's technology. ActiveAds is really something deeper than an interactive advertising system: It's a Java-based platform for streaming applications in constrained environments. ActiveAds sends a 7k micro-client over the network to establish a framework for other functions. Software components, including graphics and application functions, are then streamed down to the micro-client as needed. Instead of downloading an entire application at once, ActiveAds sends only the elements necessary at a particular time, based on user activity. Consequently, applications developed with ActiveAds use far less bandwidth and memory than they would otherwise.

According to Thinking Media ceo Owen Davis, "What this allows you to do is have real functionality on the client side." Davis admits that the company is ahead of the market, but believes that eventually wireless information devices will need to run executables on the client side. As he explains, "The issue that everybody is going to face is, what's going to drive the content providers?” Davis believes content providers will want the extensible functionality a client-side approach allows.

ActiveAds is a perfect solution for wireless information devices. With ActiveAds, smart phones, PDAs and other appliances with wireless connections can deliver/support a far wider range of applications than otherwise. The only catch is that the client devices must use Java. However, Symbian’s recent alliance with Sun (see page 11) means that at least one major wireless data platform will meet this criterion in the near future.

Davis says the company is building applications for the Symbian platform now, although it will support any wireless devices running Java. The Palm VII, for example, connects to the Internet only through a special proxy server. If customers want to receive content not supported through Palm’s proxy server, they are out of luck. To address this limitation, Thinking Media is writing a Java-based micro-browser that can plug in functionality in real-time, allowing users to connect to any proxy server they wish.

Embedded networking

Computers are everywhere, but most of them were not designed to be networked. In particular, millions of commercial and industrial devices have embedded microprocessors. Some day, perhaps soon, these devices will be built with the Net in mind, but even then today’s installed base will persist for many years. Still, any device with some sort of external port can be connected to a network with the right software and hardware.

Some of the most exciting sites in the early days of the commercial Internet were the networked vending machines and cameras that enterprising graduate students rigged up. Webcams are now prevalent and available as prepackaged software and hardware bundles, but mostly for entertainment purposes. Most of the conceivable applications for networking embedded processor devices seem either mundane or silly. The killer apps will appear obvious only in hindsight, but we’re confident they are out there. Moreover, there will be thousands of “micro-killer apps” for vertical markets. Virtually any company with a fleet of cars, trucks, field equipment or field personnel will benefit from the ability to tie people and things together over a network.

Java Embedded Server

Sun announced its Java Embedded Server (JES) in October. The approximately 100k application server runs on top of any real-time operating system on embedded-processor devices. It allows these devices to communicate via HTTP, and also makes it possible to deploy new services on the fly. In other words, rather than hard-wiring software into a device, companies can remotely update functions over the Web, or can allow applications to load temporarily and delete them when they are no longer needed.

Thus, a bank could remotely add stock trading to its ATMs, or a wireless service provider could automatically update a local mapping application when a user travels. Energy companies and others with widely dispersed metering devices are particularly interested. As John Fowler, engineering manager for Java products, explains, “The customers we’re talking to don’t want to put people in trucks.” He says the next version of JES will allow the server itself, not just the services it supports, to be upgraded remotely on the fly.

JES can complement Jini, Sun’s technology for resource sharing among connected devices. (See the section on Bill Joy in Release 1.0, 3-98, for a discussion of Jini.) JES provides a foundation for putting devices on the network and installing new services; Jini could serve as one of those services to allow those devices to share information with other elements of the network. The first version of JES, however, isn’t yet compatible with Jini. Sun has promised Jini integration in the next version, originally planned for the end of 1998 but now scheduled for the second half of 1999. According to Fowler, JES will be able to host the Jini location service and will also function as a Jini bridge, so that individual devices on a network need not have Jini or Java capability built into them.

Sun is also working to improve scalability to handle remote upgrading on networks with millions of nodes, and is also building native extensible markup language (XML) capabilities into JES 2.0.

The most significant change in JES 2.0, however, will be support for the open service gateway interface (OSGI) specification. OSGI is an initiative launched last month by 15 technology companies including Alcatel, Ericsson, IBM, Lucent, Motorola, Network Computer Inc., Nortel, Oracle, Philips, Sun, Sybase and Toshiba to create a common specification for connecting home networks to Internet-based applications and services. OSGI will be a Java-based platform that integrates with other networking protocols such as HomePNA, Bluetooth, HomeRF and CEBus (see Release 1.0, 12-98). It will allow a single point of presence to manage networked functions within the home, without requiring an always-on PC in the middle of things.

Fowler says Ericsson approached Sun when it saw similarities between JES and the nascent OSGI effort. The rapid swelling of interest in OSGI has been a pleasant surprise to Sun, which expected the commercial/industrial market for embedded device networking to take off before the home market. However, there are significant potential synergies between the two markets. For example, energy companies have generally been unable to justify deploying remote home energy management, despite the massive potential cost savings. If such a service can piggyback on an already-deployed OSGI gateway, however, the economics change dramatically for the better.

Lantronix

What about all the machines already in the field? Rather than waiting until they can be replaced with new models running embedded Web servers, these devices can be connected to the Net through less-powerful but less expensive thin servers.

Lantronix, based in Irvine, CA, has been building thin servers since 1989. It now has 100 employees and hasn’t needed venture funding because it has been profitable from the beginning. The company’s primary products today are file and printer servers; it has shipped over 1.5 million units during its history. However, Lantronix ceo Fred Thiel has a broader vision. File and print servers are special-purpose devices, but the underlying hardware can be used for other functions.

Thiel points out that typical office or commercial buildings already have five or six separate device networks: elevators, fire alarms, heating/ ventilation/air conditioning, lighting, video security, access controls, etc. They also increasingly have Ethernets, but not connected in any way to these networks. If all of these devices could be tied together and IP-enabled, it would open up a wealth of new applications. A fire alarm could give the fire department a map of the building along with the ability to control elevators, sprinklers and doors remotely. A door alarm could e-mail an alert to the alarm company along with an attached audio recording to verify that the door was in fact opened.

Lantronix's universal thin servers allow any device with a serial port to connect via IP over an Ethernet network. Most industrial devices, such as vending machines and building control systems, already include serial ports. Lantronix's IP stack also works on networks using Novell's IPX protocol and Digital's LAT protocol. Every device gets its own address, which allows it to be recognized over the network without an intervening PC. These commercial devices are typically connected through private networks, so Lantronix's thin servers use whatever internal addressing system is in place. When IPv6 arrives each device will be able to have a separate IP address, but for now that's unnecessary.

Thus, almost any device with an embedded microcontroller can be remotely controlled over the Net. What if every vending machine could automatically report when it was empty, or could update sales figures in real time? Security systems, heating and air conditioning controls and bar code scanners are other types of devices that could benefit greatly from Internet connectivity. In such industrial environments, deploying a PC for network connectivity makes no sense, because it would be too big, expensive and crash-prone. Lantronix's thin servers, about the size of an automatic garage door opener, can be configured remotely through a telnet connection.

Earlier this month Lantronix announced that it was participating in Sun's Jini initiative. Thiel says Lantronix is working on a universal Jini server that comes with a set of generic device objects. Jini eliminates the need for custom device drivers to take advantage of the functionality of different devices, beyond simply tying them into the network.

NEW APPLICATIONS FOR A CONNECTED WORLD

In thinking about ubiquitous networking, it’s important to separate IP from the Web. IP is a communications protocol, and the Web is an application that runs on top of it. The Web was instrumental to the growth of the commercial Internet, because of its ease of use and multimedia capabilities. However, the Web was designed for home and office PCs. Portable and industrial devices don’t generally have 15-inch color screens, Pentium processors or mice.

For the most part, wireless and embedded networks will provide lower bandwidth than home and office connections. While it might be nice to view streaming video clips on your cell phone, the added value of such applications simply doesn’t justify the costs of delivering the necessary bandwidth over wireless networks. One fundamental truth of the connected world is the realization that every device doesn’t have to do it all. Simple networked applications that wouldn’t justify the price of a PC, such as notification and real-time mapping, may provide sufficient utility to pay for a handheld device and low-bandwidth wireless connection. Personal-area connectivity between devices will magnify the value of inexpensive, limited-function handheld appliances.

Imagine if every morning before driving to work you could view live pictures of the traffic along your normal route and alternate routes. TV stations are already beginning to use Webcams for real-time traffic monitoring, but such a service would be much more valuable on a personalized basis.

In general, though, the first killer application will likely be remote monitoring. There are countless pieces of equipment deployed in the field that could notify headquarters when something goes wrong, saving time and money by avoiding the need for human meter-readers and monitors. At a minimum, these devices would send information only when something went wrong, although continuous updates would foster additional applications.

Eventually, there will be powerful synergies between personal and embedded-device networking. Imagine the potential when stationary commercial and industrial devices are widely connected, and users carry always-on networked devices with them. Information exchanges will happen automatically, so people won’t have to wait on lines or swipe credit cards to establish their identity. Most devices will be remotely controllable. Geo-targeted information will be particularly valuable: Today’s Internet mapping applications are nothing compared to carrying around a constantly updated information repository about the area around you.

Of course, all this will have to go hand-in-hand with security and privacy infrastructures. The more personal data is transmitted over the airwaves, the more potential there is to intercept that information. Encryption technologies can address the basic eavesdropping problem if they are designed into systems. The deeper challenge will come as mobile devices are increasingly vested with identity. Easy access to information is valuable, but you wouldn’t want someone who picked up your PDA instantly to have access to your house, e-mail account and bank account. Biometrics will eventually play an important role here, but it will also be important to have end-to-end trust networks.

As we warned at the outset, this future in all its glory is years off. Vertical applications and wireless enabling of Internet services such as e-mail and the Web will dominate the market for some time, even once the technical and economic hurdles are overcome. Each of the intermediate steps, though, represents a significant opportunity.

COMING SOON

- How big companies innovate.
- The Net swallows the phone network.
- Living on the Web.
- And much more... (If you know of any good examples of the categories listed above, please let us know.)

ANOTHER PERSPECTIVE ON “THE ARCHITECTURE OF INTERNET 2.0”

In February we ran an article about high-speed Internet access services. We’re concerned that cable companies and others are refusing to open their systems to independent Internet service providers, which we believe will slow deployment and the pace of innovation. We think the Internet model of open access would be better for everyone, including the cable operators.

We received the following letter from an old FCC friend and colleague. Barbara Esbin is now at the law firm of Dow, Lohnes & Albertson, where among other things she represents cable operators. While at the FCC she authored an important white paper on Internet services over cable. We print this letter in the interest of presenting both sides of the debate. If you haven’t read the original article, it’s available on our Website at ***www.edventure.com/release1/cable.html****. — Kevin Werbach*

By Barbara Esbin

In the February 19, 1999 issue of Release 1.0, Kevin Werbach addresses the ongoing policy debate on cable unbundling in “*The Architecture of Internet 2.0*” (“*Internet 2.0*”). While advocating marketplace solutions to the alleged problems posed for “independent ISPs” by cable’s Internet architecture, Werbach posits that “government prodding” may be the only way to get the parties to the table. Yet, no explanation is offered as to why government intervention is necessary simply because some ISPs and on-line service providers have determined that they would like unbundled access to cable systems.

Government intervention is not sought at the other end of the connection, where the largest Internet backbone providers are currently free to peer or not to peer with whomever they choose. Nor is there a call for government intervention to regulate transiting agreements. Anyone interested in the future of the Internet should understand that the question of mandated interconnection among ISPs and cable operators cannot be viewed in isolation from the larger question of ISP-to-ISP connectivity.

The public interest is served, not threatened, because cable operators are building integrated applications on top of network infrastructure. They are investing billions of dollars to provide *facilities-based* competition across several communications markets, including voice, video and data. Cable’s investment is what is spurring competing telco DSL rollouts.

Government intervention should be avoided unless there is a public interest “value added.” But, that is nowhere evident. In the dial-up context, an ISP receives a telephone call from a subscriber’s computer and transforms the modem signal to pure Internet Protocol (IP) traffic for routing to and from the Internet. ISPs may also offer content and other services, but the primary value-added service is “access.” In short, ISPs get you on the Internet. And that is precisely what cable provided Internet access does as well.

The key question becomes: What added functionality does an “independent ISP” provide that is not provided by the cable ISP connection?

In the cable Internet world, the addition of an “independent ISP” serves no value-added role. Cable providers enable data services, including e-mail and other applications, through their CMTS equipment. The CMTS is the nerve center in a data-enabled cable system: It takes the signal transmitted from the home over cable plant, transforms it into IP traffic, and does the reverse for incoming data. The shared structure of the cable network makes having more than one provider of CMTS equipment redundant and problematic. The net result is that once the CMTS is in place, a consumer has Internet access and no “independent ISP” is necessary. Indeed, adding another ISP serves no function other than to arbitrarily route IP traffic to some other place. The question becomes, what is the role of the ISP? Does the ISP provide anything more than Internet connectivity, or is there some other “value added?” Are there separate classes of ISPs, some of whom deserve carriage over cable because they provide more than just basic transport, and some who deserve no mandated carriage because they do not? How would so-called Internet portals fare under mandated ISP access? In, or out?

In addition to the problem of defining who is to benefit from regulatory intervention, the structure of cable networks necessarily means that the cable operator will be heavily involved in managing any data service offered over its network. The proposed Canadian regulation that Werbach suggests is solving the cable data problem has in fact avoided dealing with these thorny operational issues altogether. US regulators would not have the same luxury if they choose to impose an unbundling requirement. When one factors in the rapid pace of Internet development, any regulatory requirement might well be overtaken by changing technology or business practices before it could be implemented.

Finally, Werbach’s unsupported claims that cable operators fear competition in their core video markets have little to do with the motivations of a cable operator attempting to provide new, untested services in the dynamically changing Internet marketplace. Werbach’s claim that cable’s alleged “vision” is “not the Internet.” is puzzling as well. The model for the Internet is that anyone can connect to the backbone and, thanks to IP, communicate with any other person connected to it. Access to the backbone is through a variety of means, some “open” and some not. From Werbach’s perspective “open” appears only to refer to the connection between the user and the ISP, since no ISP allows others to share its connection to the Internet. There are many systems and local networks besides the cable systems that are not open to unaffiliated providers, including some newer access technologies, such as DirecPC, universities and businesses.

Werbach seems disturbed by the hypothetical and improbable possibility that cable operators could filter URLs and block access. The fact is that cable is not blocking access to any Web site or other Internet address today. Blocking access to available content on the Internet makes no business sense whatsoever. Moreover, it defies reason to claim that “users would have no alternative.” Users would have every alternative that exists today, in addition to the many alternatives that will come into existence in the near term.

A three-party negotiation session among cable, “independent ISPs” and the government is hardly a market-based solution. More importantly, cable’s architecture and how it is utilized by cable operators for the provision of

Internet services are not “moral” issues. They are business issues based on rational economic and technical considerations. Any government intervention, whether in the form of a suggestion or an order, presumes a result. That result is an arrangement that is satisfactory to ISPs that want to use the cable platform, regardless of the economics or technological impacts.

Even a “non-binding” policy statement in favor of sharing cable facilities implies that government will impose mandatory access requirements and rates if private negotiations fail. It would be unprecedented for government to intervene in ISP relationships in this way, and would certainly make it easier to impose other regulation on the Internet and ISPs in the future. If the Internet includes the “last mile” to the home, calls for mandated interconnection arrangements between cable and unaffiliated ISPs must be understood for what they are: calls for regulation of “the Internet.”

We are indeed at “the fork in the road.” The question is whether there will be a strong continuation of broadband facilities investment by the many stakeholders in this competitive marketplace. It would be a pity if, instead of a nation of facilities-based communications providers, we became a nation primarily of resellers and repackagers. Global competitiveness will not be furthered by policies that heavily promote resale over facilities-based business strategies.

A highly regulatory rate-of-return regime for unbundling competitive cable Internet access facilities has no public policy or legal predicate. High bandwidth Internet access is now and will continue to be highly competitive. In this context, cable controls no essential facility. Government intrusion in the form of unbundling is the regulatory camel’s nose under the Internet tent. Everyone who hopes to keep the Internet free from regulatory burdens should resist this. Old fashioned telephone regulation is the last thing needed for the Internet to continue to flourish.

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For further reading:

Don Norman, The Invisible Computer

Michael Curry, “New Technologies and the Ontology of Places,” unpublished paper distributed via the Red Rock Eater News Service and available at www.tao.ca/wind/rre/0644.html.

RELEASE 1.0 CALENDAR

1999

April 26-27	**VirComm '99** - San Francisco, CA. Creating, building, growing, and managing virtual communities. For information call (800) 248-8466, ext. 524; fax, (203) 761-1444; www.vir-comm.com.
April 26-29	**ISPCON Spring 99** - Baltimore, MD. The largest ISP trade show, now owned by Mecklermedia, er make that Penton Media. For information call (800) 632-5537; ispcon.internet.com/spring99.
April 27-29	**Internet & Electronic Commerce '99** - New York, NY. How to make money on the Net. Call (800) 331-5706; fax, (218) 723-9122; www-iec-expo.com.
May 10-14	**Networld + Interop** - Las Vegas, NV. More bandwidth than you can shake a stick at. To register, call (888) 886-4057; fax, (781) 449-2674; www.interop.com.
May 21-23	**Foresight "Group Genius" Weekend** - Palo Alto, CA. Annual gathering on long-term technological change. Call (650) 917 1122; fax, (650) 917 1123; inform@foresight.org; www.foresight.org/SrAssoc/99Gathering/.
May 23-25	**#SOHO Summit** - Carlsbad, CA. Strategies and alliance-making for companies targeting the SOHO (small office/home office) market. Call (914) 255-7165; fax, (914) 255-2116; www.sohosummit.com.
May 23-25	**iBand 2** - San Francisco, CA. The industry's premiere technical conference on quality of service, bandwidth management and high-bandwidth technologies. Register at https://www.stardust.com/events/iband2/registration.htm. Send questions to Marty Bickford, (408) 879-8080; marty@stardust.com.
May 25-26	**Understanding the Digital Economy** - Washington, DC. Sponsored by the US Department of Commerce to review research on the implications of the digital economy, and to examine the agenda for future research. Contact Teresa Vicente; (301) 975-3883; fax, (301) 948-2067; e-mail digital_economy@ita.doc.gov; www.digitaleconomy.gov.
May 25-27	***ICANN Board and Open Meetings** - Berlin, Germany. Come hear about developments in domain-name policy and other Net-platform issues. For info, see www.icann.org.
June 3	**5th Human Factors and the Web conference** — Gaithersberg, MD. Hosted by the National Institute of Standards and Technology. Contact Sharon Laskowski, (301) 975-4535; fax, (301) 975-5287; hfweb@nist.gov; www.nist.gov/hfweb.
June 14-17	**GigaWorld IT Forum '99** - Scottsdale, Arizona. For info contact Adrienne Kennedy, (781) 792-2643; fax, (781) 982-1724; akennedy@gigaweb.com; www.gigaweb.com/events.

June 22-24	**PC Expo - New York, NY**. Over 100,000 corporate technology buyers in search of new toys. Sponsored by Miller Freeman; keynote speakers include Bob Herbold and Chuck Geschke. For information, call (800) 829-3976; www.pcexpo.com.
June 22-25	***INET '99** - San Jose, CA. The Internet Society's annual conference. For information e-mail inet99-register@isoc.org; www.isoc.org/inet99/. ED speaking
July 1-2	**NetMedia 99** - London. European Internet conference for journalists. For information call 44 (171) 477-8036; fax 44 (171) 477-8563; e-mail conference@city.ac.uk; www.soi.city.ac.uk/netmedia.
July 14-17	**Genetic and Evolutionary Computation Conference** - Orlando, FL. Joint meeting of the 8th International Conference on Genetic Algorithms and the 4th annual Genetic Programming Conference. For information call (650) 328-3123; fax, (650) 321-4457; e-mail gecco@aaai.org; www-illigal.ge.uiuc.edu/gecco/.
July 15-17	**The Wizards of OS: Operating Systems and Social Systems** - Berlin. Examines the meaning of operating systems as the foundation of the contemporary information society. Contact Volker Grassmuck, 49 (30) 313-2795 or 49 (30) 2093-3180; vgrass@rz.hu-berlin.de.
September 25-27	**#Telecommunications Policy Roundtable Conference** - Alexandria, VA. The premier event for policy wonks interested in telecom-related technology issues. For information, contact Dawn Higgins, (202) 452-9033; e-mail tprc@ei.com; www.si.umich.edu/~prie/tprc/.
October 10-17	**Telecom 99 / Inter@ctive 99** - Geneva, Switzerland. The International Telecommunications Union's massive telecom conference and trade show. Call 41 (22) 730-6161; fax, 41 (22) 730-6444; e-mail telecom99@itu.int; www.itu.int/telecom.
October 18-19	**International Symposium on Wearable Computers** - San Francisco, CA. Sponsored by IEEE. For information call David Mizell, (425) 865-2705; fax, (425) 865-2965; david.mizell@boeing.com; iswc.gatech.edu.
October 24-26	****EDventure's Tenth Annual High-Tech Forum** - Budapest, Hungary. Call Daphne Kis, (212) 924-8800; fax, (212) 924-0240; daphne@edventure.com; www.edventure.com.

** Events Esther plans to attend.*
# Events Kevin plans to attend.

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